1 OBSERVING AND INFERRING

EXPERIMENT

Text Reference
Section 1.3

PURPOSE

To practice making accurate and complete observations of physical and chemical processes and to learn how to formulate hypotheses that account for these observations.

BACKGROUND

Throughout the day you continually use your senses to observe the world. You hear your alarm clock go off in the morning, you smell lunch as you approach the school cafeteria, and you see your friend walking down the hall toward you.

You can make inferences based upon your observations. If your car won't start and you also observe that the radio, horn, and lights do not work, you might infer (or hypothesize) that your car battery is dead.

Observation, followed by the development of a hypothesis, is the first step in the scientific method. Experiments (tests) are then designed and carried out to test the hypothesis under controlled conditions. If the results of the initial experiment support the hypothesis, additional testing is done to further check the hypothesis. If, however, the experimental results do not support the original hypothesis, then the hypothesis must be changed or modified. When the results of many, many experiments support the hypothesis, it can be called a theory. A theory is a hypothesis that is supported by the results of repeated experiments.

In this experiment you will observe a series of chemical and physical phenomena demonstrated by your teacher. You will then formulate hypotheses to explain your observations.

MATERIALS (PER CLASS)

safety goggles
3 100-mL beakers
3 250-mL beakers
1 2-L graduated cylinder
1 crucible tongs
3 watch glasses
4 glass stirring rods
1 plastic wash bottle
2 insulated gloves
saturated calcium ethanoate, $(CH_3COO)_2Ca$
0.05*M* silver nitrate, $AgNO_3$ [C] [T]
0.1*M* sodium hydroxide, NaOH [C] [T]
3% hydrogen peroxide, H_2O_2
cornstarch, $(C_6H_{10}O_5)_n$
copper wire, Cu
95% ethanol, C_2H_5OH [F]
ice, $H_2O(s)$
dry ice, $CO_2(s)$ [C]
manganese(IV) oxide, MnO_2 [T]
wood splints
matches
universal indicator solution
distilled water

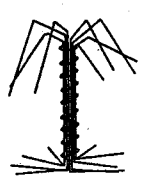


Figure 1.1

SAFETY FIRST!

In this lab, your teacher will perform the demonstrations. Some of the solutions may contain harmful materials. Handle chemicals only when instructed to do so by the teacher. Observe all precautions, especially the ones listed below. If you see a safety icon beside a step in the procedure, refer to the list below for its meaning.

Caution: Do not touch the dry ice. It can cause frostbite. Use insulated gloves or tongs. (Step 1)

Caution: Wear your safety goggles. (All steps.)

Caution: Avoid contact with silver nitrate solution. It can cause temporary skin discoloration and skin burns. (Step 3.)

Caution: Ethanol is flammable. (Step 6.)

Note: Your teacher will properly dispose of the materials.

PROCEDURE

Demonstration. Record your observations in Data Table 1.

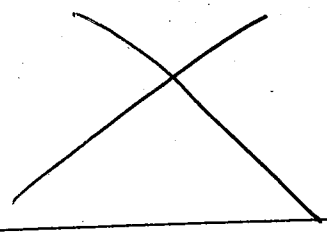
1. Place a piece of ice and a piece of dry ice on separate watch glasses. Observe what happens with time.
2. Add 30 g of cornstarch to three 100-ml beakers containing 10 mL, 15 mL, and 20 mL of water, respectively. Observe what happens when each mixture is stirred with its own glass stirring rod and when some of each mixture is picked up with the rod.
3. Place the copper wire tree (Figure 1.1) in a 250-mL beaker containing 200 mL of the silver nitrate solution. Observe this system at intervals during the class period.
4. Place several small pieces of dry ice in a plastic wash bottle half-filled with distilled water. Observe what happens when the jet assembly of the wash bottle is replaced and tightened.
5. Add a small amount of manganese(IV) oxide powder to 50 mL of hydrogen peroxide solution in a 250-mL beaker. Cover the beaker with a watch glass for 15 seconds. Observe what happens when a *glowing* wood splint is inserted into the upper part of the beaker.
6. Observe what happens when 25 mL of saturated calcium ethanoate is poured into a 250-mL beaker containing 25 mL of ethanol.
7. Add about 20 drops of universal indicator solution to 1500 mL of water in a 2-L graduated cylinder. Record what happens when 150 mL of sodium hydroxide solution is added and the mixture is stirred. Observe what occurs when several small pieces of dry ice are added.

Teacher demo

Name _____ Class _____ Date _____

OBSERVATIONS

DATA TABLE 1: OBSERVATIONS

System	Observations
ice	
dry ice	
cornstarch 10 mL H_2O cornstarch 15 mL H_2O cornstarch 20 mL H_2O	
Cu(*s*) $AgNO_3$(*aq*)	
dry ice wash bottle	
MnO_2(*s*) H_2O_2(*aq*)	
$(CH_3COO)_2Ca$(*aq*) C_2H_5OH(*aq*)	
H_2O (teacher demo) universal indicator NaOH(*aq*)	

ANALYSES AND CONCLUSIONS

For each demonstration, write two hypotheses that could explain the behavior that you observed. Indicate which of the two you believe to be the better hypothesis, and give reasons for your choice.

1. ice

_____

_____

_____

Name _____ Class _____ Date _____

2. dry ice

3. cornstarch and water

4. copper and silver nitrate

5. dry ice in water-filled wash bottle

6. manganese(IV) oxide, hydrogen peroxide, and wood splint

7. calcium ethanoate and ethanol

8. sodium hydroxide, dry ice, and water with an indicator

GOING FURTHER

Design an Experiment

Propose experiments to test one or more of your hypotheses above. If resources are available and you have your teacher's permission, perform the experiment.